METHOD OF MAKING AND CURING CONCRETE TEST SPECIMENS IN THE FIELD

FOP FOR AASHTO T 23

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Significance

Concrete is specified primarily on the basis of strength. Standard specimens are made and subsequently tested to determine the acceptability of concrete. Concrete strength test specimens are made in accordance with a standard procedure to produce results that are reliable and tests that can be reproduced by someone else with the same concrete, following the same procedures.

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Specimens are molded according to standard procedures and then cured under proper temperature and moisture conditions. Deviation from the standard procedures can cause significant differences in strength results. For example, specimens improperly cured between 32º and 38° C (90º and 100°F) will develop strength at a different rate than specimens cured at the specified temperature range of 16º to 27° C (60º to 80°F) required by this method. Ultimate strength is also affected.

Typical Strength Specimens

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This FOP pertains to specimens cast for the purpose of acceptance. Agencies sometimes specify curing practices other than those presented here. (To determine adequacy of protection or when a structure may be placed in service for example.)

Scope

This procedure covers the method for making, initially curing, and transporting concrete test specimens in the field in accordance with AASHTO T 23.

Apparatus and Test Specimens

- Concrete cylinder molds: Conforming to AASHTO M 205 with a length equal to twice the diameter. Standard specimens shall be 150 mm (6 in.) by 300 mm (12 in.) cylinders. Mold diameter must be at least three times maximum aggregate size unless wet sieving is conducted according to FOP for WAQTC TM 2. Agency specifications may allow cylinder molds of 100 mm (4 in.) by 200 mm (8 in.) size when the nominal maximum aggregate size does not exceed 25 mm (1 in.).

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- Beam molds: Rectangular in shape with ends and sides at right angles to each other. Must be sufficiently rigid to resist warpage. Surfaces must be smooth. Molds shall produce length no more than 1.6 mm (1/16") shorter than that required (greater length is allowed). Maximum variation from nominal cross section shall not exceed 3.2 mm (1/8 in.). Ratio of width to depth may not exceed 1.5; the smaller dimension must be at least 3 times maximum aggregate size. Unless otherwise noted in specifications, beam molds for casting specimens in the field shall result in specimens having width and depth of not less than 150 mm (6 inches). Specimens shall be cast and hardened with the long axes horizontal.
- Standard tamping rod: 16 mm (5/8 in.) diameter and approximately 600 mm (24 in.) long, having a hemispherical tip for preparing 150mm (6 in.) x 300 mm (12 in.) cylinders.
- Small tamping rod: 10 mm (3/8 in.) diameter and approximately 305 mm (12 in.) long, having a hemispherical tip for preparing 100 mm (4 in.) x 200 mm (8 in.) cylinders
- Vibrator: At least 7000 vibrations per minute, diameter no more than ¼ the diameter or width of the mold and at least 75 mm (3 in.) longer than the section being vibrated for use with low slump concrete.
- Scoop
- Trowel or Float
- Mallet: With a rubber or rawhide head having a mass of 0.57 ±0.23 kg (1.25 ±0.5 lb.).

Apparatus, Cylinders

- Rigid base plates and cover plates: metal, glass, or plywood.
- Initial Curing Facilities: Temperature controlled curing box or enclosure capable of maintaining the required range of 16º to 27°C (60º to 80°F) during the entire initial curing period (for concrete with compressive strength of 40 Mpa (6000 psi) or more, the temperature shall be 20º to 26°C (68º to 78ºF). As an alternative, sand or earth for initial cylinder protection may be used provided that the required temperature range is maintained and the specimens are not damaged.
- Thermometer: Capable of registering both maximum and minimum temperatures during the initial cure.

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Procedure – Making Specimens – General

1. Obtain the sample according with the FOP for WAQTC TM 2. Wet Sieving per the FOP for WAQTC TM 2 is required when concrete contains aggregate with a nominal maximum size greater than 50 mm (2 in.) for specimen's with a 150 mm (6 in.) diameter, or greater than 25 mm (1 in.) for specimen's with a 100 mm (4 in.) diameter.
2. Remix the sample after transporting to testing location.
3. Begin making specimens within 15 minutes of obtaining the sample.

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4. Set molds upright on a level rigid base in a location free from vibration and relatively close to where they will be stored.
5. Fill molds in the required number of layers attempting to exactly fill the mold on the final layer. Add or remove concrete prior to completion of consolidation to avoid a deficiency or excess of concrete.

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6. There are two methods of consolidating the concrete – rodding and internal vibration. If the slump is greater than 25 mm (1 in.), consolidation may be by rodding or vibration. When the slump is 25 mm (1 in.) or less,

consolidate the sample by internal vibration. Agency specifications may dictate when rodding or vibration will be used.

Procedure – Making Cylinders – Rodding

1. For the standard 150 mm (6 in.) by 300 mm (12 in.) specimen, fill each mold in three approximately equal layers, moving the scoop or trowel around the perimeter of the mold to evenly distribute the concrete. For the 100 mm (4 in.) by 200 mm (8 in.) specimen, fill the mold in two layers. When filling the final layer, slightly overfill the mold.
2. Consolidate each layer with 25 strokes of the appropriate tamping rod, using the rounded end. Distribute strokes evenly over the cross section of the concrete. Rod the first layer throughout its depth without forcibly hitting the bottom. For subsequent layers, rod the layer throughout its depth penetrating approximately 25 mm (1 in.) into the underlying layer.
3. After rodding each layer, tap the sides of each mold 10 to 15 times with the mallet (reusable steel molds) or lightly with the open hand (single-use light-gauge molds).
4. Strike off the surface of the molds with tamping rod, or straightedge and begin initial curing.

Note 1: Floating or troweling is permitted instead of striking off with rod or straightedge

Consolidation of concrete in cylinder by rodding

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Vibrating cylinder specimens

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Procedure – Making Cylinders – Internal Vibration

1. Fill the mold in two layers.
2. Insert the vibrator at the required number of different points for each layer (two points for 150 mm (6 in.) diameter cylinders; one point for 100 mm (4 in.) diameter cylinders). When vibrating the bottom layer, do not let the vibrator touch the bottom or sides of the mold. When vibrating the top layer, the vibrator shall penetrate into the underlying layer approximately 25 mm (1 in.).
3. Remove the vibrator slowly, so that no air pockets are left in the material.

Note 2: Continue vibration only long enough to achieve proper consolidation of the concrete. Over vibration may cause segregation and loss of appreciable quantities of intentionally entrained air.

4. Strike off the surface of the molds with tamping rod, or straightedge and begin initial curing.

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Making a flexural beam, rodding

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Procedure – Making Flexural Beams – Rodding

1. Fill the mold in two approximately equal layers with the second layer slightly overfilling the mold.
2. Consolidate each layer with the tamping rod once for every 1300 mm^2 (2 in^2) using the rounded end. Rod each layer throughout its depth taking care to not forcibly strike the bottom of the mold when compacting the first layer. Rod the second layer throughout its depth, penetrating approximately 25 mm (1”) into the lower layer.
3. After rodding each layer, strike the mold 10 to 15 times with the mallet and spade along the sides and end using a trowel.
4. Strike off to a flat surface using a trowel and begin initial curing.

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Procedure – Making Flexural Beams – Vibration

1. Fill the mold to overflowing in one layer.
2. Consolidate the concrete by inserting the vibrator vertically along the centerline at intervals not exceeding 150 mm (6 in.). Take care to not over vibrate, and withdraw the vibrator slowly to avoid large voids. Do not contact the bottom or sides of the mold with the vibrator.
3. After vibrating, strike the mold 10 to 15 times with the mallet.
4. Strike off to a flat surface using a trowel and begin initial curing.

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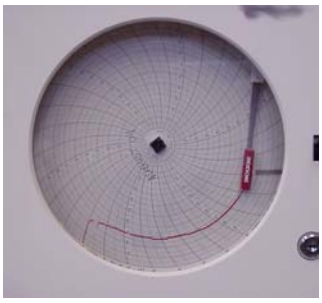
Procedure – Initial Curing



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Recording Thermometer

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- When moving cylinder specimens made with single use molds, support the bottom of the mold with trowel, hand or other device.
- For initial curing of cylinders, there are two methods, use of which depends on the agency. In both methods, the curing place must be firm, within ¼ in. of a level surface, and free from vibrations or other disturbances.
- Maintain initial curing temperature of 16º to 27°C (60º to 80°F) or 20º to 26°C (68º to 78°F) for concrete with strength of 40 Mpa (6000 psi) or more.
- Prevent loss of moisture.

Temperature Controlled Curing Box

Placing cover plate

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Method 1 – Initial cure in a temperature controlled chest-type curing box

1. Finish the cylinder using the tamping rod, straightedge, float or trowel. The finished surface shall be flat with no projections or
25 depressions greater than 6.3 mm (1/8 in.).
2. Place the mold in the curing box. When lifting light-gauge molds be careful to avoid distortion
26 (support the bottom, avoid squeezing the sides).
3. Place the lid on the mold to prevent moisture loss.
4. Mark the necessary identification data on the cylinder mold and lid.

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Method 2 – Initial cure by burying in earth or by using a curing box over the cylinder

Note 3: This procedure may not be the preferred method of initial curing due to problems in maintaining the required range of temperature.

1. Move the cylinder with excess concrete to the initial curing location.
2. Mark the necessary identification data on the cylinder mold and lid.
3. Place the cylinder on level sand or earth, or on a board, and pile sand or earth around the cylinder to within 50 mm (2 in.) of the top.
4. Finish the cylinder using the tamping rod, straightedge, float or trowel. Use a sawing motion across the top of the mold. The finished
28 surface shall be flat with no projections or depressions greater than 6.3 mm (1/8 in.).
5. If required by the agency, place a cover plate on top of the cylinder and leave it in place for the duration of the curing period or place the lid on the mold to prevent moisture loss.

Specimen identification

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Procedure – Transporting Specimens

After 24 to 48 hours of initial curing, the specimens will be transported to the laboratory for storing under standard conditions. Specimen identity will be noted along with the date / time the specimen was made and the maximum and minimum temperatures registered during the initial cure.

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- While in transport, specimens shall be protected from jarring, extreme changes in temperature, freezing, or moisture loss.
- Cylinders shall be secured so that the axis is vertical.
- Transportation time shall not exceed 4 hours.

Final Curing

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- For all specimens (cylinders or beams) final curing must be started within 30 minutes of mold removal. Temperature shall be maintained at 23° ±2° C (73º ±3° F) Free moisture must be present on the surfaces of the specimens during the entire curing period. Curing may be accomplished in a moist room or water tank conforming to M 201.
- For cylinders, during the final 3 hours prior to testing the temperature requirement may be waived, but free moisture must be maintained on specimen surfaces at all times until tested.
- Final curing of beams must include immersing in lime-saturated water for at least 20 hours prior to testing.

Report

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- Report on standard agency forms.
- Placement information for identification of

project, element(s) represented, etc.

- Date molded & Time molded.
- Test ages.
- Slump, Air Content & density.
- Temperature (concrete, initial cure max. & min., and ambient).
- Method of initial curing.
- Other information as required by agency such as concrete supplier, truck number, invoice number, water added, etc.

Tips!

- Start within 15 minutes of obtaining sample.
- Use hand, for tapping single-use, light-gauge molds.
- Consolidation technique depends on the slump. Rodding and/or vibration may be appropriate for different slumps.
- Protect specimens from damage during transport and keep cylinders vertical.

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REVIEW QUESTIONS

1. AASHTO T 23 gives standardized procedures for _____, _____, and _____ of test specimens.

2. Describe two methods for initially curing test specimens.

3. When consolidating a flexural strength test specimen by rodding, rod one stroke for each _____ of top surface area.

4. Describe the process for making flexural beam specimens using internal vibration. What precautions must be taken?

5. During transportation, what must be done to protect test specimens?

PERFORMANCE EXAM CHECKLIST

MAKING AND CURING CONCRETE TEST SPECIMENS IN THE FIELD FOP FOR AASHTO T 23

Participant Name _____ Exam Date _____

Record the symbols "P" for passing or "F" for failing on each step of the checklist.

Procedure Element	**Trial 1**	**Trial 2**
1. Molds placed on a level, rigid, horizontal surface free of vibration?	_____	_____
2. Representative sample selected?	_____	_____
3. Making of specimens begun within 15 minutes of sampling?	_____	_____
4. Concrete placed in the mold, moving a scoop or trowel around the perimeter of the mold to evenly distribute the concrete as discharged?	_____	_____
5. Mold filled in equal layers, attempting to exactly fill the mold on the last layer?	_____	_____
6. Each layer rodded throughout its depth 25 times with hemispherical end of rod, uniformly distributing strokes?	_____	_____
7. Bottom layer rodded throughout its depth?	_____	_____
8. Subsequent layer(s) rodded throughout depth penetrating 25 mm (1 in.) into the underlying layer?	_____	_____
9. Sides of the mold tapped 10-15 times after rodding each layer?		
a. With mallet for reusable steel molds	_____	_____
b. With the open hand for flexible light-gauge molds	_____	_____
10. Concrete struck off with tamping rod or, if necessary, finished with a trowel or float?	_____	_____
11. Specimens covered with non-absorptive, non-reactive cap or plate?	_____	_____

Comments: First attempt: Pass ☐ Fail ☐ Second attempt: Pass ☐ Fail ☐

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Examiner Signature _____WAQTC #:_____

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